REMARKS

Applicants would like to thank the Examiner for the careful consideration given to this case and the courteous interview with Applicants' representative John Pillion on January 4, 2008. During the interview the claims and their numbering, the Shenderov reference, and general electrowetting on dielectrics (EWOD) technology were discussed. The Examiner will decide whether to re-number the claims after consideration of the amendments in this paper.

Applicants have filed an Information Disclosure Statement under 37 CFR 1.97 (c)(2) along with the fee set forth in § 1.17(p). According to the MPEP § 609, an information disclosure statement shall be considered by the Office if filed after the period specified in paragraph (b), provided that the information disclosure statement is filed before the mailing date of a final action under § 1.113, a notice of allowance under § 1.311, or an action that otherwise closes prosecution in the application. Applicants' Information Disclosure is being filed before the mailing date of a final office action.

The Applicants' specification, paragraph [0081] on page 31, was amended to replace the text "< 0. 2% F. S." with "less than 0.2% full scale" and to replace the text "<0.05% F. S." with "less than 0.05% full scale." Applicants' respectfully submit that the replacement text is mere rephrasing. According to the MPEP § 2163.07:

> "Mere rephrasing of a passage does not constitute new matter. Accordingly, a rewording of a passage where the same meaning remains intact is permissible. In re Anderson, 471 F.2d 1237, 176 USPQ 331 (CCPA 1973). The mere inclusion of dictionary or art recognized definitions known at the time of filing an application would not be considered new matter. If there are multiple definitions for a term and a definition is added to the application, it must be clear from the application as filed that applicant intended a particular definition, in order to avoid an issue of new matter and/or lack of written description."

Applicants respectfully submit that it is clear from the application as filed that Applicants intended this particular definition and request that these amendments be entered. No new matter has been added.

Claims 1-30 are pending in the case including omitted claim 12. Applicants have canceled claims 8-15 and claim 30 from the application, and preserve the right to pursue these claims in one or more continuing applications. No new matter has been added.

Claim 1 was amended for antecedent basis by adding the term non-porous adherent coating into the claim and by reciting that the substrate is a sensor with a non-porous adherent coating with a thickness of greater than 50 microns (see Applicants' specification, pp. 12, paragraph [0018]) and that the non-porous adherent coating is protective and protects the sensor substrate from corrosion by said fluid above 25°C (see Applicants' specification, pp. 21, paragraph [0051]) .

Claim 2 was amended for antecedent basis by adding the term non-porous adherent coating and further reciting that the coating protects the sensor substrate from corrosion by said fluid above 50 °C as described in Applicants' specification pp. 21, paragraph [0051].

Claim 4 was amended for antecedent basis by adding the term "non-porous adherent" into the claim.

Claim 5 was amended to recite that the non-porous adherent coating protects the sensor substrate and structures on one or more surfaces of the sensor, said structures chosen from the group consisting of resistive, capacitive, transistors, electrical contacts, optical contacts, or a combination of these as described in Applicants' specification paragraph [0012] last three lines.

Claim 6 was amended to recite that the slope of the calibration curve for the sensor including the non-porous adherent protective coating and a slope of the calibration curve for a sensor without the non-porous adherent protective coating are nearly identical and have an

offset of less than 0.2% full scale. Support for these amendments can be found in Applicants' specification pp. 15, paragraph [0035], and FIG. 3 (**emphasis added**):

> [0035] FIG. 3 shows calibration data for a **sensor with and without the adherent non- porous coating** of the present invention at various times. The **slopes of the calibration curve are nearly identical and indicate that the uncoated sensor had nearly the same sensitivity as the sensor after coating and that the sensitivity of the coated sensor** does not change over the period of time.

Further support for these amendments can also be found in Applicants' specification, pp. 31, paragraphs [0081] and [0082]:

> [0081] Calibration data from a single Metallux pressure sensor; uncoated, with a 2.5 mil (0.0063 cm) CYTOP coating and with a 5 mil (0.013 cm) CYTOP coating showed that there was no significant difference between the sensitivity for any of the conditions (uncoated, 2.5 mil, or 5 mil) as illustrated in FIG. 3.
>
> [0082] Metallux data show an offset shift < 0. 2% F. S. after 2,000, 000 F. S. pressure cycles and an offset shift of <0.05% F. S. after 110 hours at 82°C.

Applicants' maintain that one skilled in the art would know that "< 0.2% F.S." in paragraph [0082] refers to "less than 0.2% full scale."

Claim 7 was amended for antecedent basis to recite that the coating is a non-porous adherent coating with a thickness of more than 100 microns as described in Applicants' specification paragraph [0018] and Example 2, pp. 33, [0091].

Claim 16 was amended for antecedent basis to show that the sensor has a non-porous adherent coating on a surface of the sensor that contacts a fluid, said sensor with the non-porous adherent coating includes structures for measuring the physical response of the sensor in contact with the fluid as described in Applicants' specification , paragraph [0012], lines 15-16

and paragraph [0013] lines 14-18. Further, claim 16 recites that the non-porous adherent coating includes a fluorine containing poly-oligomer that is chemically bonded to the sensor surface, that the thickness of the coating is greater than 50 microns (see Applicants' specification pp. 12, [0018]), and that the non-porous coating protects the sensor from corrosion above 25°C in the fluid (Applicants' specification pp. 21, paragraph [0051] lines 6-8).

Claims 17-19 were amended for antecedent basis. Claim 17 was also amended to recite that the non-porous adherent coating is free of voids as described in Applicants' specification paragraph [0065], line 3 . Claim 18 was amended to recite that the coated sensor is a pressure sensor that is a ceramic material (see Applicants' specification, pp, 22, paragraph [0054] lines 1-3).

Claim 20 was amended to recite the coated sensor of claim 16 where the fluid is 10% HCl and where the coating protects the sensor from corrosion at 50 °C in said fluid, see Applicants' specification, pp. 32, paragraph [0088].

Claim 21 was amended to include antecedent basis for a fluid contacting surface of the sensor substrate as described in Applicants' specification (pp. 9, lines 7-10, [0015]) and to recited that the non-porous coating on the fluid contacting surface of said sensor substrate has a thickness of greater than 50 microns (see Applicants' specification, pp. 12, paragraph [0018]). Claims 22-29 were amended for antecedent basis of claim elements recited in claim 21.

Item 3. Claims 8-15 were canceled. Claims 16-20 were amended to establish a dimension of greater than 50 microns with respect to the thickness of the coating as described above. Applicants' respectfully submit that the amended claims are clear and request that the Examiner's rejection be withdrawn.

Item 4. The Examiner has asked the Applicant to show that claims 1-30 are patentable. Claims 8-15 and claim 30 were canceled.

Claim 1 and claim 16 have been amended to recite that the non-porous adherent coating has a thickness of greater than 50 microns and that the non-porous adherent coating is protective in that is protects the sensor substrate from corrosion above 25°C in the fluid. Support for these amendments can be found in Applicants' specification paragraphs [0014] on page 8 and paragraphs [0050]-[0051] on page 21.

Shenderov discloses an electrowetting on dielectric (EWOD) microfluidic device that is used to move drops of electrolytic liquid in channels. The electrowetting device or apparatus is disclosed as having a hydrophobic layer 22a that is electrically insulative (see paragraph [0023] of Shenderov) and as having a hydrophobic layer 26a that is electrically insulative and preferably is detachable- i.e. it is not an adherent coating (see paragraph [0024] of Shenderov).

Shenderov in paragraph [0023] teaches that the upper layer 22b of the bottom plate 22 overlies the electrodes 22a and should be hydrophobic and can be made by the *application* of a hydrophobic coating like Teflon AF ™ or Cytop™. Shenderov does not teach a sensor substrate and does not teach forming an adherent coating or a protective non-porous coating of a fluorine containing poly-oligomer bonded to a sensor substrate. Shenderov does not teach a coating that has a thickness of greater than 50 microns that is protective and protects the underlying sensor substrate from corrosion.

For the electrowetting (EWOD) apparatus disclosed by Shenderov, the following equations show the relationship between the contact angle of the liquid and the applied voltage:

$$\cos\theta_v = \cos\theta_o + \frac{\varepsilon\varepsilon_o}{2\gamma_{LV}t}\mathrm{V}^2 \text{ which can be rearranged to: } (\cos\theta_v - \cos\theta_o) = \frac{\varepsilon\varepsilon_o}{2\gamma_{LV}t}V^2$$

In this equation, θ_v is the contact angle of the liquid when a potential (V) is applied, θ_o is the contact angle of the liquid without applied potential, ε is the dielectric constant of the insulating or dielectric layer (in Shenderov's case Teflon AF or Cytop), ε_o is the dielectric constant of air, γ_{LV} is the surface tension at the liquid-vapor interface, t is thickness of the

insulating layer, and V is the applied voltage. According to this equation, the difference between the contact angle of the liquid with the potential (V) applied θ_v and without the potential applied θ_o will **increase** with a **smaller thickness "t"** of the dielectric layer (Teflon AF or Cytop layer in Shenderov) and the difference will also increase with **a larger dielectric constant** "ε" of the dielectric layer (Teflon AF or Cytop layer in Shenderov). Larger differences between the contact angle of the liquid with the potential applied θ_v and without the potential applied θ_o will result in greater movement of the liquid at lower voltages (V) in microfluidic applications utilizing electrowetting like Shenderov. Shenderov is silent about the thickness of the dielectric (Teflon AF or Cytop) layer.

According to Moon, et al as disclosed in J. Appl. Phys. (2002), vol. 92, pp. 4080, col. 2, "For EWOD to be widely useful, particularly in integrated microfluidics, the voltage requirements need to be lowered." According to Moon, a high voltage is (>200 V) and lower voltages are desirable to prevent breakdown of the thin dielectric layer and prevent electrolysis of the liquid (col. 2, pp. 4080). As disclosed in Moon, there have been efforts to reduce the voltage requirement to as low as 6 V by thinning the dielectric or insulating layer for example by using 130 Å (0.013 micron) thin films of Teflon AF (see Saeki, et al, Polymeric Materials: Science and Engineering (2001), vol. 85, pp. 12, Table 1). In the Saeki, et al reference, the results in Table 1 clearly show that for Teflon AF films, the threshold voltage (the voltage at which the contact angle changes visibly- Saeki, col. 2, pp. 12, last two lines) decreases from 46 volts for a Teflon AF coating of 16,500 angstroms (1.65 microns) to 5.9 volts for a Teflon AF film of 130 angstroms (0.013 microns); *the threshold voltage decreases as the coating thickness decreases.*

Moon discloses achieving a high 40 degree contact angle change at low voltage (15 volts) by **using thin insulating layers** (a smaller "t") of various **high dielectric constant** materials (larger "ε") that have been coated with a very thin 200 Å (0.02 micron) hydrophobic layer of Teflon AF. Specifically, Moon et al, presents results of experiments and modeling (see Moon, FIG. 3, FIG. 10, and FIG. 11) for the voltage (V) required to obtain a 40 degree contact angle change using high dielectric materials like a 400 Å (0.04 micron) thin film of Teflon AF (ϵ =1.9-2.1); a 1000 Å (0.1 micron) thin film of SiO_2 (ϵ =3.8) with a 200 Å Teflon AF overcoat; a

10,000 Å (1 micron) thin film of SiO_2 (ϵ =3.8) with a 200 Å Teflon AF overcoat; a 12 micron thin film of paraylene C (ϵ = 2.7) with a 200 Å Teflon AF overcoat; a 1000 Å (0.1 micron) thin film of silicon nitride Å (ϵ =7.8) with a 200 Å Teflon AF overcoat, and a 700 Å (0.07 micron) thin film of barium strontium titanate (ϵ = 180) with a 200 Å Teflon AF overcoat. The results from Moon show that the lowest threshold voltage is achieved with the thinnest insulator layer and highest dielectric constant; these results are summarized in the Table below along with the reference citation in Moon for the result:

Coating	ϵ	Coating Thickness w/o 200 A Teflon AF	Threshold voltage (V)	Moon ref
Teflon AF	1.9-2.1	(400 Å)	50-60	FIG. 3
Parylene C + 200Å Teflon AF	2.7 (Saeki et al, pp 13)	(12 micron)	> 220	pp. 4084, col. 2
SiO_2 + 200Å Teflon AF	3.8	(1000 Å)	~25	pp. 4084, col. 2, and FIG. 10
SiO_2 + 200Å Teflon AF	3.8	(1 micron)	65-80	pp. 4084, col. 2
SiN + 200Å Teflon AF	7.8	(1000 Å)	~22	FIG. 10
$(Ba_{0.7}Sr_{0.3})TiO_3$ + 200Å Teflon AF	(180)	700 Å	~15	FIG 11, col. 1, lines 9-12, pp4086

Because Teflon AF has about the same or lower dielectric constant compared to Parylene C, a thick 12 micron coating of Teflon AF would be expected to require voltages greater than about 220 V to show a similar contact angle change. In view of Moon et al and Saeki et al, one skilled in the art of electrowetting like Shenderov would not be motivated to use

thick 50 micron Teflon AF coatings or other thick coatings of fluorine containing poly-oligomers as the insulating or hydrophobic layer for EWOD since it would increase the voltage required to operate the device or result in less wetting for a fixed voltage and reduce the transport of drops in the device of Shenderov. Accordingly claims 1-7 and claims 16-29 are patentable and Applicants respectfully request that the Examiner's rejection be withdrawn.

In view of the remarks presented above, it is respectfully submitted that all of the claims are in condition for final allowance and notice to such effect is respectfully requested. Although Applicants believes no fees are due, the Commissioner is hereby authorized to charge deposit account No. **501-908** for any fees that may be due in connection with this response. Should the Examiner have any questions regarding these remarks, the Examiner is invited to initiate a telephone conference with the undersigned.

Respectfully Submitted,

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